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J. S. Howe

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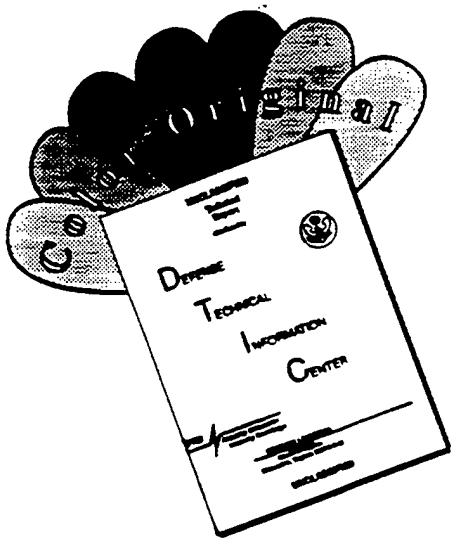

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J.S. Howe

Ship Structures and Materials Division
Aeronautical and Maritime Research Laboratory

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ABSTRACT

The Ship Survivability Enhancement Program (SSEP) was devised to generate scientific data in research areas related to the survivability of ships and crews against attack from modern weapons. The experiments were concerned with electronic radiation, fire, smoke, exploding missile warheads and limpet mines. Damage control and fire fighting methods were also studied.

The experiments were carried out in 1994 on the recently de-commissioned RAN destroyer-escort, ex HMAS DERWENT, and there were specific criteria established for them to be accepted into the program.The site for the program were the waters of Cockburn Sound, close to the RAN facilities on Garden Island, the major Australian west coast naval base, which offered infrastructure support so important to the success of the work. The experiment schedule occupied nearly five months, requiring considerable movement of staff and equipment between their home bases and the test location.

This report describes the considerable planning and management measures required to satisfy all of the constraints imposed by the RAN and DSTO and these included the approved budget, risk management, environmental considerations and OH&S aspects. The report explains how the program required continual on-site liaison with essential support groups and how it was continuously monitored and controlled to ensure that it was operating within the defined constraints and that scientific objectives were being realised.

The report starts with the setting of the objectives and management arrangements and the critical issues are addressed in detail. The support roles of the various Navy elements involved are defined. Risk management was a factor which required special attention, especially with its potential for negative publicity for the RAN and DSTO, should adverse situations have arisen. No such circumstances did occur. OH&S matters followed similar lines. The local PR campaign waged principally by the Public Affairs Office at HMAS STIRLING was an outstanding success and showed the benefit of pro-active publicity which was astutely managed by Navy.

The program was deemed to be an outstanding success. Nonetheless, there were lessons learned and these are also reported.

This report does not cover the scientific outcomes which are reported elsewhere by the task managers who directed their own experiments.

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PO Box 4331
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Telephone: (03) 9626 8111
Fax: (03) 9626 8999

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Executive Summary

The Ship Survivability Enhancement Program (SSEP) consisted of a sequence of research experiments carried out on the ex-HMAS DERWENT in 1994. The experiments were aligned to DSTO's research activities aimed at enhancing the survivability of RAN ships and crews.

The program was a culmination of three years of planning and preparation with the joint involvement of DSTO and RAN staff. It was completed on time and within budget with DSTO financial and other resources coming from normal Divisional allocations. The SSEP met nearly every planned research objective with minimal disruption by unplanned or unexpected occurrences. However, there were many large issues to be addressed during the planning, almost any of which had the potential for terminating the program.

The overall success of the SSEP from a project management perspective was the confirmation that all of the planning requirements identified during the concept stage, and executed during the development stage, (refs 1,2), proved vital in generating an eventual conclusion which was accepted by all as a very satisfactory one. Since the completion of the program, the major initial output has been the processing and analysis of voluminous data records. In addition, the main scientists involved in the experiments have given presentations on the scientific outcomes to varied audiences, including a large one at HMAS STIRLING itself. The presentations developed somewhat into a "roadshow", although in most cases they were given as the result of specific requests; in other cases they were given in appreciation for support rendered. The RAN has demonstrated great interest in the DSTO outputs and has responded very favourably to the briefings.

The only major deficiency recognised by the author was the lack of a corporate plan to develop and implement a strategy for achieving public exposure of the organisation through the vehicle of the SSEP. In spite of such need for PR planning being reflected in the requirement as promulgated under DSI 8/94 to identify opportunities for PR exposure, there was little evidence during the SSEP of any pro-active corporate approach by DSTO.

Although not the subject of this report, it can be confidently predicted that positive outcomes will result from this program which will be reflected in future changes to methods of ship construction, equipment selection, damage control and operational procedures. Eventually, there may also be some "spin offs" in the application of lessons learned to non military areas, such as methods to combat the effects of explosions, fires and smoke flow in civilian structures.

The scientific outcomes will be reported by the individual task managers involved.

Contents

1. Introduction

The concept of the Ship Survivability Enhancement Program (SSEP) was first proposed by the Director, Naval Combat Survivability and Seamanship (DNCSS) in 1991 when HMAS DERWENT was earmarked for de-commissioning in 1994. At this time it was suggested that DERWENT could be used for research purposes by being the vehicle for a series of destructive experiments, similar to the earlier UK HULVUL series, but designed to be more relevant to Australia's needs.

The suggestion was taken up by the Aeronautical and Maritime Research Laboratory, AMRL, (then the Materials Research Laboratory, MRL) and a feasibility study[1] was prepared for DSTO and RAN consideration. The concept was agreed to in principle and a development plan[2] was then drawn up. This plan was accepted and final approvals to proceed with the experimental program were given in December, 1993.

2. Program Objectives

The experiments were devised to benefit various DSTO research initiatives by providing the opportunity to acquire unique vulnerability and survivability information relevant to RAN ships and crews in the following five key areas:

(1) The significance of the interaction of ultra-wide-band electromagnetic radiation with a ship's electronic systems.

(2) The effectiveness of various conventional and novel warheads in structural and combat system vulnerability studies and personnel protection considerations.

(3) The intensity and spread characteristics of ship-board fires.

(4) The effectiveness of limpet mines and defence against them.

(5) Damage control and fire fighting effectiveness evaluation.

In addition to these survivability aspects there were important implications for the relevance of naval engineering standards and current ship construction practices, and the extent and relevance of current training methods.

Principally because of constraints on available resources, some experiments proposed in the feasibility study[1] were later omitted from the program. These omissions included the underwater shock experiments which could have given Australia some invaluable data in the area of shock, an area in which we are currently deficient.

Although reported elsewhere[1], it is worth repeating the basic rules established whereby the experiments were chosen for inclusion in the program, viz:

(1) the experiments had to be unique,

(2) time and costs were to be realistic,

(3) no major structural alterations to the ship were allowed,

(4) the experiments had to have relevance to modern navy conflict,

(5) they were to be non-trivial,

(6) they must answer questions of importance,

(7) the requirement must be for a non-operational ship.

This report does not address the scientific aspects of the program which will be covered in detail in specific research papers by the various scientists involved.

3. Program Schedule

The schedule is listed in table 1. The program commenced on 30th July, 1994, ie., immediately prior to DERWENT's arrival at HMAS STIRLING and just before its de-commissioning, and extended to 2 December, 1994. This period covered all of the preparatory work on site and on the ship as well as the full program of experiments.

On the 21st December, DERWENT was sunk in 200m of water at a location approx. 24km west of Rottnest Island, WA.

At the conclusion of the ultra-wide-band electromagnetic radiation experiments and after de-commissioning, the ship went into its Paying Off Availability (POA) phase during which it was stripped of all items and equipment required for other purposes and not to be retained for the SSEP experiments.

During the latter part of the POA, staff from AMRL and the Fleet Intermediate Maintenance Activity (FIMA) branch, carried out some ship preparation and installation work for the experiments to follow. Immediately after the de-commissioning, the ship's crew was reduced in numbers substantially, and during the POA and SSEP periods there were further reductions in numbers to levels below those originally expected. Consequently, the ship's planned staffing needs for the SSEP were never fully realised and assistance by the volunteer crew members with DSTO tasks was also less than expected.

The schedule and locations for the experiments on the ship are illustrated in table 1. The personnel involved with the experiments are listed in table 2. This is provided to illustrate the level of DSTO activity and movements involved.

4. Management Arrangements

During the concept development phase, the executive management group for the SSEP comprised Dr R.L.Woodward, Research Leader Vulnerability and Armour, AMRL, and CMDR J.S.Mathias, A-NSA[1]. Dr D.M. Pinkerton, Research Leader, Vulnerability, replaced Dr Woodward as scientific director late in the development phase. The group was expanded in the program development phase

with the inclusion of Lt G.E. Prince, Navy Implementation Manager from DNW, and the author, DSTO Co-ordinator SSEP.

The latter two established a management group office at HMAS STIRLING and managed the program on site. It was quite clear once the program got into full swing that the management group would have functioned much more efficiently if it had been augmented with an administrative assistant. The real need for this requirement had been underestimated during the planning phase. The deficiency was covered by the SSEP Coordinator carrying out these duties together with the Navy Implementation Manager, but only with a reduction in time spent on their major responsibilities. In particular, these lesser tasks reduced their available time for ship-board responsibilities.

In conformity with normal AMRL practice, a Technical Instruction was issued for the SSEP[3]. A TI is a compilation of field experiment details, working arrangements and responsibilities. It is the document which must be approved before any field activity can proceed. In the case of the SSEP, a global TI was issued as well as more specific sub-ordinate TIs, one for each group of experiments.

During the development phase, the executive group was actively engaged in establishing contact with the various bodies who were on the periphery of the program but who had vested interests in its conduct or outcomes. These included the Commonwealth EPA, the WA Department of Environmental Protection, Commonwealth Department of Transport, Fremantle Ports and Harbours, WA Local Government, dive groups and others. During the conduct of the program CMDR Mathias was also involved in the complex issue regarding the final disposal of the ship.

5. HMAS STIRLING Support

At an early stage, close liaison was established with those RAN branches on Garden Island(GI), whose assistance was critical to the successful conduct of the SSEP. It was subsequently proven how important this early contact and continual liaison became to produce the relatively smooth progress achieved for the duration of the experiment program. Liaison was maintained at both Commissioned Officer and Non-Commissioned Officer levels. Assistance to DSTO was always forthcoming, even at very short notice. The facilities and services made available at STIRLING and the readiness with which all Navy staff gave support when asked, ensured that the program proceeded with few hitches. It was most gratifying and very motivating for DSTO staff when they realised that the SSEP seemed to figure as something especially important in the minds of those whose assistance was sought.

The RAN organisation at GI consisted of HMAS STIRLING and "lodger units". The GI organisation and those elements which had involvement with the SSEP are recognised as follows in the roles and services they provided.

Senior Executive, HMAS STIRLING
The Commanding Officer of HMAS STIRLING, Commodore Rob Partington, and Captain John Wood, Chief of Staff had control over all SSEP activities. They were both kept briefed on progress and specific important issues throughout the program. Public affairs and environmental considerations were two specific areas requiring close liaison with them. They remained highly supportive of the program throughout.

Head, Base Administration Support Centre (CMDR Peter Mangan)
Interaction with HBASC covered a range of requirements. These included registry, visits liaison, stand-by fire services, photographic unit, public affairs, the registration of security clearance details

and the issuing of GI access passes for participants and observers, both Australian and foreign in origin.

Head, Health Services (LCDR Maron)
As well as providing OH&S coverage for the ship's crew, the well equipped on-site medical centre under his control was made available for emergency use for the benefit of DSTO staff if required. Fortunately, this latter service was never called upon. A PO medic was always at the site during the explosion experiments.

Head, Logistic Services(CMDR Tony Andrews)
The services provided by this area were heavily utilised by the SSEP. These included the use of tugs and work boats, berthing and mooring of DERWENT, light crane services at the mooring, heavy and light crane services on the wharves and land area, some local loading/unloading and transport of DSTO equipment and use of the purchasing section in arranging for the hire of special local equipment and services.

Tugs and workboats were also used to provide a sentinel role in ensuring that other boats did not encroach within the safety radius for the experiments.

This organisation also provided general goods receipt and despatch services as well as small quantities of AVCAT, aviation fuel, which was used as the liquid propellant in the large fire experiments. The clothing store provided reject footwear and clothing items used as fuel load in those experiments.

5.1 Lodger Units at Garden Island

Clearance Diving Team Four (LCDR Paul Papalia)
The services provided by this area were extensive and virtually continuous throughout the last 2 months of the experiment program. A firing officer was provided by them for all of the explosive events and the team provided explosives transport between the ammunition wharf and the ship using their own boat, SHARK. They also provided a sentinel role in ensuring that the safety radius for the experiments was not breached.

Their most demanding role was in supporting the limpet mine experiments. In this they handled all of the underwater activities including the installation of the high speed camera box, the placement of all mine and countermine devices and initiated all explosive charges. In addition, they carried out all of the underwater welding and repairs to damage caused by the explosions. This was very demanding work, especially having to force form under water large steel plates to the contour of the hull before welding them in place and thus sealing the hull. Their involvement also caused them a great inconvenience in working outside their normal hours to achieve the level of repair required to proceed with the mine experiments.

Commander, Australian Submarine Squadron
Cinema and conference room facilities in the Submarine Systems Training Centre were provided by this organisation, through the Australian Submarine Corporation who manage the facilities.

Fleet Intermediate Maintenance Authority (FIMA)
The main support from this area came from the Pipe and Plate workshop (WO Peter Beard). Their work included the cutting of openings in the hull and internal bulkheads of the ship, the fabrication and fitting of adjustable cover plates for the hull openings and the painting of the black and white

grids on various outside surfaces required as spatial references for high speed cameras. FIMA recorded 1000 man hours in support of the program. This was recorded as 820 hrs for Pipe and Plate, and 180 hrs for Ship's Husbandry. This was a huge contribution to the program.

Maritime Headquarters - West
This organisation issued the instructions to the media regarding restrictions to apply regarding the proximity of aircraft and seacraft to the SSEP experiment area. These instructions were issued as "Notice to Aircraft and Mariners (NOTAMs)"

RAN Armament and Weapon Equipment Depot, RANAWED (Mr J. Van Brink)
This organisation provided the receipt and storehouse services for all explosives and flammable materials. They also provided the transport as required of all of these items to the ammunition wharf for loading onto SHARK.

Stores Inventory Review Team, WA (SIRT), (WO Eric Jones)
This organisation was responsible for the de-storing of DERWENT during the POA and assisted in retaining on-board those items which DSTO identified as important for the success of the experiments. The organisation also provided office space and support facilities and services for the SSEP management office. Some loading/unloading and storage services were also provided.

6. Resources

There were no special resources assigned by DSTO to this program. It was funded exclusively using normal resources which were diverted from other work which had a lower priority at the time. The total planned cost to DSTO was estimated[2] at $1.2M and the final outcome should see a level of expenditure close to that figure being realised.

Details of expenditure will be recorded in the DSTO task reporting process.

7. Special Management Issues

There were a number of matters related to the conduct of the SSEP activities which warrant specific comment. These are as follows;

7.1 Risk Management

There were issues requiring attention in managing the risk associated with the conduct of the SSEP. These were:

(a) the accidental sinking of the ship at the buoy

(b) an uncontrolled fire in the ship

(c) environmental damage and pollution

The accidental sinking of the ship would have had serious consequences because of the hazard it would have posed to other ships using the shipping lanes in Cockburn Sound. The plan implemented to minimise this risk was to have the ship inspected and certified for hull strength before proceeding with each event. This procedure was followed and the inspection and certification was carried out by Mr Zhia Ahmed from the Directorate of Naval Architecture in Defence, Canberra. On no occasion did the program require modification due to loss of ship hull strength.

Adequate watchkeeping together with fire fighting back-up arrangements ensured that no incipient inboard fires could develop to the stage of getting beyond control.

The environmental matters are considered in detail in 7.4 below.

7.2 Location

Fleet Base west was chosen as the venue for the SSEP for a number of reasons. Firstly it was the home for DERWENT and some of its crew, and it was to be de-commissioned there. Secondly, it provided suitable protected waters; it had buoys which were licensed for explosives as well as superb berthing, harbour and infrastructure facilities. Thirdly, environmental requirements and safety distances were achievable, and it was close to civilian sources for ad-hoc supplies. The choice as the location to carry out the program proved an excellent choice in all aspects except its remoteness from the home base for the DSTO staff involved. This did impose a high cost penalty for airfares, although other sites closer to the DSTO home laboratories would have caused an escalation in other costs. The grouping together of the diverse experiments into a continuous program did have cost benefits. However, whether the ship was moored alongside or at "Bravo" buoy, the site proved ideal. The location proved to be a relatively sheltered one, although there were times when maintaining the moorings when the ship was alongside at the ammunition wharf for the electromagnetic experiments, did pose problems when strong southerlies blew in.

7.3 Experiment Schedule

By and large the experiments kept very much to the original schedule except for the slight rearrangements caused by the firing difficulties experienced with experiment C3, and by the problems experienced in repairing the damage caused by the limpet mine experiment, M6. Meeting this schedule was a credit to both DSTO and Navy staff alike.

However, it needs reporting that for the blast/fragmentation series at least, the program was a little too intensive in that there were too many experiments in the time scheduled. This had noticeable enervating effects on the DSTO and RAN personnel involved, especially those working on-board the ship in conditions which were extremely poor, and potentially dangerous near the end of the program. I also believe that the busy schedule caused undue demands on those supplying the local support to us, although there were no complaints expressed as such. It could be argued that the program was excessively long overall, however, on the other side of the ledger, a much smaller program would have been less cost effective and may have provided insufficient justification to obtain the ship for this work.

The compartments chosen and the order in which the experiments were carried out were also vindicated. Interference in the form of excessive damage from one experiment impinging on the integrity of a later experiment nearby was minimal.

7.4 Environmental Matters

There was a host of environmental issues which were recognised as being potential problem areas. These issues were concerned with the following:

liberated smoke - smoke liberated particularly from the fire experiments proved to be of the order expected and never approached the high levels being liberated from the nearby Kwinana complex. The prevailing winds("Fremantle doctor") always provided good smoke dispersal. This was a good feature of the area.

on-board asbestos - this was removed well before the SSEP.

oil and fuel spills - the ship's fuel and oil reservoirs and lines were emptied and cleaned during the POA period and hence there was little possibility of significant spillage during the experiments.

debris - there was some floating debris generated by some of the on-board explosions, however this was quickly collected at the time and disposed of using approved methods.

damage to sea-life - there were no visible signs nor reported sightings of physical distress or injury to sea life from any of the experiments.

damage to seagrass - there were no signs of seagrass damage from the experiments. As the water depth at the ship's mooring was 19 m, no nearby seagrass was at risk.

annoyance levels of noise - it was recognised during the planning that although there was no likelihood of window damage from the large on-board explosions, levels of noise may cause annoyance to the public especially under certain weather conditions. Consultants commissioned by Defence Facilities Branch at our request, carried out measurements of impulse noise levels generated by several of the largest on-board explosions. These measurements were made on Garden Island and on the beach in nearby Rockingham. The measured noise was below the level likely to cause annoyance and maybe prompt complaints and no complaints were in fact registered. In addition, through the local radio stations, the local population was advised of impending explosions by HMAS STIRLING's Public Affairs office. This achieved a level of public awareness which had positive effects.

Complaints were received, however, regarding other explosions from demolitions unrelated to the SSEP, carried out on land near the northern end of GI. A summary of the report of noise measurements supplied by the National Acoustic Laboratories is attached as table 3.

Generally, the wind conditions dispersed the noise from SSEP events away from populated areas.

7.5 Occupational Health & Safety

One of the most pleasing features of the SSEP was that no injuries or health problems were reported by staff during the entire program. This was a result I believe of good RAN practices and sound planning and preparation and sensible practices adopted by the DSTO staff who were largely very experienced in working in the "field", although not so much on board ships.

OH & S was an issue addressed in considerable detail during the detail planning phase of the SSEP and it was given detailed coverage in the Technical Instruction issued for the program. The issue was covered in the body of the Instruction and in Appendix 1 which was the Operations Order Issued by the RAN for the SSEP. Staff were briefed on specific hazards and safety on a daily basis as soon as they boarded the ship.

OH & S issues were as follows:

gaseous products from introduced materials - during the POA period and as part of the experimental program, a number of commercial thermal barrier coatings were applied to bulkheads and cable looms within the ship. The application of the coatings required the use of a solvent, reported as essentially being commercial grade of methyl isobutyl ketone(MIBK). The odours liberated from the use of this solvent did persist on-board for many days, in spite of the use of forced ventilation. Although both DSTO and Navy staff, when unprotected, experienced discomfort from the unpleasant odours, the respirators provided did ensure adequate protection for those who had to enter the worst affected areas.

gaseous products from combustion - the generation of gases and depletion of oxygen were anticipated from the fires and explosions and measurements were continually carried out; affected areas were verified as safe before staff were allowed entry.

air-borne glass fibres from damaged insulation - as anticipated, small airborne glass fibres were present after the explosions. Personnel wore appropriate respirators when necessary. Clearance of the fibres due to natural venting to the atmosphere was fairly rapid after the events. The application of water spray was an option in fibre clearance.

hazards from damaged decks and bulkheads - the ship incurred considerable damage during the program. This took the form of displaced equipment which had broken loose from its fixed position in the ship, as well as cut and buckled sections of the structure itself. Some hull sections and decks had large holes blown out and sharp and jagged metal edges were commonplace. As a typical example, 01 deck adjacent to the bridge, was torn and buckled upwards about 1m, caused by the explosion in the Operations Room. Some entire bulkheads were torn completely away from their position in the structure. Measures were taken to minimise access to some dangerous areas.

liquid spillage - fire fighting operations were the cause of considerable presence of liquid spillage below decks. Personnel had to exercise care to prevent slipping and falling in those conditions.

low levels of lighting - emergency lighting was required fairly early in the blast/fragmentation series due to irreparable damage to the ship's reticulated power system. Battery powered emergency flashing beacons and chemi-luminescent sticks proved very useful in the darkness by alerting people to specific hazards. Ad-hoc generator driven lighting was installed on a regular basis. All power generators were fitted with residual current devices to remove/minimise the possibility of electrocution.

personal safety equipment - the clothing and safety equipment which was either issued on a personal basis or available for use by DSTO staff included; cotton overalls, safety boots or shoes, hard hats, safety glasses, face shields, disposable overalls, ear muffs and ear plugs,

respirators with cartridges for gases and particulates, welding gloves and face shields, torches and UV blockout cream.

7.6 Other Shipboard Activities

On an opportunity basis and pre-planned, there were a number of exercises carried out on the ship "after hours" by military and paramilitary groups. These caused no interference to the SSEP activities. There was one such exercise however which was cancelled because of the intended use of lead-cased explosive charges. Lead was prohibited by the on-site SSEP management group on OH&S grounds.

7.7 Public Relations

Public awareness of the SSEP from Navy's perspective was an outstanding success and was expected to produce material for Navy publicity for many months after the completion of the program. Stories were continually being fed to the WA press. Press articles were many and varied. In addition, radio stations were briefed as specific experiments came up. On many occasions, radio announcements of imminent explosions were made. For the two largest explosions, all 4 television networks were present to record the events and for live interviews. DSTO provided the networks with some of its own spectacular "footage" recorded on-board during the events, to complement the networks' own recordings made from a distance. This material appeared on all networks in WA, and on some in the eastern states. Navy was the big winner in this, but the name of DSTO hardly ever appeared on television; we fared a little better in the written media.

PR exposure from DSTO's perspective was disappointing, being an opportunity lost. Our PR organisation failed, the author believes, to take advantage of one of the best opportunities DSTO has had to gain recognition by the general public, in Western Australia at least. The fault, the author believes, lies with the organisation itself. There is a public affairs (PA) office at HMAS STIRLING and that office was effective in feeding information to the media. DSTO failed in not working along similar lines. The SSEP Management Group did what they could to assist in this by continually interacting with the PA office but the total outcome could not be described as satisfactory. The potential for good PR for DSTO was seemingly underestimated.

media cover achieved - DERWENT's arrival home to STIRLING, de-commissioning, destructive experiments and ultimate fate were all the subject of substantial coverage in the WA media; at least weekly there were press stories and letters covering the issues. The stories resulted from contacts and releases prepared by the Public Affairs office at STIRLING, which always acknowledged DSTO's activities in the SSEP.

Television coverage in WA was also considerable on a number of occasions.

DERWENT was considered by the WA media and public to be their ship and hence a high level of media exposure was predictable. However, media exposure in the remainder of the country was to be expected to be much lower and was so.

DSTO PR - The author had considerable interaction with the Navy Public Affairs office. The reasons for this were twofold; to ensure the correctness from the SSEP viewpoint of the releases from that office, and to fill the vacuum by an otherwise absence of DSTO PR initiative. The DSTO public relations people let Navy handle all of this PR, which the author

believes showed a lack of proactive involvement on their part. Lack of funding should not have been a problem because there was plenty of time for planning PR activities.

However, the Navy public affairs office at STIRLING did all that they could to highlight DSTO in their PR releases.

8. Damage Control and Fire Fighting

There were a number of issues which arose in this area. We had need of a "Red Devil" which is a proprietary name for a particular high capacity ducted air blower used for extracting smoke and fumes from below decks. We had expected that one would be on the ship, but we later found out that DERWENT didn't carry one and no others were available. Fortunately, we were able to make other satisfactory arrangements. The fire fighting activities were very rewarding for Navy in that the strengths and weaknesses in their present equipment and procedures were very apparent. I understand that the details of the fire fighting are to be the subjects of two reports by Navy; one a paper in the Naval Engineering Bulletin on procedures by LCDR Roger Boyle, who was the Senior Officer on DERWENT for the SSEP; the other a report by W. O. Chris Ryrie, officer in charge of the Damage Control and Fire Fighting Facility at Garden Island.

9. International Involvement

From the first announcement of the intended SSEP program, there was considerable interest shown by the international scientific and defence communities in it because of its uniqueness. It was always planned to be an Australian program tailored to local needs, rather than one over modified or compromised for other interests. None-the-less, participation by the international community was invited and much interest was displayed by various agencies. As an aid for overseas visitors to enhance the benefits derived from their long distance travel to WA, two workshops were conducted by DSTO at HMAS STIRLING at the end of the blast/fragmentation series of experiments. The first of these was a TTCP meeting, KTA 1-28, Underwater Explosive Effects for Seamine Neutralisation. The second was an ABCA-7 / TTCP WTP-1 workshop. These two events and the SSEP itself attracted a large number of visitors from overseas. In addition, some special experiments were incorporated into the program and these attracted direct participation by visitors from Canada, UK and US.

10. SSEP Achievements

The SSEP activities produced a number of substantial positive outputs for *DSTO*. The major ones being:

1. the acquisition of a wealth of scientific data which will be of immense value in future vulnerability and survivability considerations for Australian naval ship design and operations; the validation of models for weapon effects and ship damage was achieved,

2. an enhanced image of DSTO within Navy,

3. an enhanced reputation for DSTO in the international scientific and defence communities for completing such a complex and invaluable series of research experiments. The SSEP will now have equipped Australia to be a more equitable contributor in sharing its scientific research with its collaborative partners in the vulnerability and survivability areas,

4. the immense benefits to DSTO staff in having worked directly with the customer on a joint project.

There is still a considerable amount of work continuing in the analysis and interpretation of the huge volume of recorded data, and in report writing.

Outputs for the *RAN* would include:

1. an appraisal based on combat realism of the appropriateness and adequacy of damage control and fire fighting equipment, operating procedures and training. Some of the problems exposed were as follows:

   shortcomings of aluminium ladders in intense fires,

   limpet mine removal difficulties,

   shortcomings in hatch design,

   difficulties with underwater welding,

   design of harbour fire tenders,

2. a better understanding of DSTO.

11. Lessons Learned

It is not intended to comment on lessons related to either research outcomes or those concerned with damage control or fire fighting activities. These will be reported elsewhere. Those lessons concerned only with the management of the program are relevant in this report.

A major outcome from the SSEP was the demonstrated proof that Australia could successfully conduct a such a high quality and complex program of research in the field. With the benefit of hindsight it was probably a little ambitious in the number of experiments incorporated in the program, however, the substantial outcomes reflect great credit on the staff involved as great demands were continually being placed on them, even on weekends.

The achievement of all of the main objectives was critically dependent on the support received from HMAS STIRLING and the lodger units on GI. If there had been a higher level of fleet activity there at the time, then the facilities at Fleet Base West would not have been as readily available, and the program would have inevitably slowed. Fleet activities were considered in the planning stage and the program was scheduled accordingly, but I doubt that it was realised at the time how critical that factor could prove to be.

In light of the fact that many items of equipment were removed from the ship during the POA which we would have preferred left in place for damage assessment, we may have been more successful by submitting early bids to reserve those items we wanted retained and in working order where possible, rather than the request we made more of a general nature, in asking for experiment compartments, and those adjacent, to be left as intact as possible. Also the ship's complement was continually being depleted and there really was nobody left who could make accurate assessments of the serviceability of equipment exposed to damage from the experiments. A more explicit request by us in this regard may have been more successful and eventuated in us gaining more quantifiable vulnerability data regarding the ship's equipment and systems. The continual depletion of the ship's complement also meant that there was less effort available to assist in DSTO tasks.

In planning for any such major field activity at a remote location in the future, careful consideration should be given to the inevitable need for having dedicated administrative/clerical support on site. The inclusion of at least one such person who also has the ability to help with technical aspects of the program may well be essential.

Communications between the SSEP team at STIRLING and the AMRL laboratory at Maribyrnong were a vital link in keeping the program moving smoothly without losing touch with other matters in the laboratory and the broader organisation. The members of the team were continually kept informed of matters which were of concern or interest to them and this was greatly appreciated. They always felt they had full support from people at their home base.

It is not difficult to quantify how successful the Navy public awareness campaign proved to be. On the basis that nearly all media exposure, including most letters to the editor and the like, was positive towards the objectives of the SSEP and Navy, and that there were no protests or demonstrations as such, then that Navy campaign was probably decisive in minimising any adverse reaction. The only opposition registered seemed to be related to some individuals' views that DERWENT deserved a better fate. Letters from the WA public which appeared in the press with headings such as "Floating museum", "Faithful ship", "Keep old ship for training", "Sad end for such a proud warship", were a reflection on the sentiment held by that community for the former DERWENT. However, that was about the extent of negative sentiment expressed publicly.

There was no visible opposition by "greenies" or environmentalists. This was quite possibly a vindication that the measures taken to ensure the program remained "environmentally friendly" and that its objectives were explained and understood by the public, were successful. No noise complaints were made concerning the explosion experiments. The tactic of measuring and monitoring noise levels proved successful. This was achieved at no cost to DSTO or Navy.

The risks of injury to the participants in the program were always present and some people not directly involved in the program, had fears that an accident "was waiting to happen". Well, through a mix of good fortune, good planning, as well as sound experience and sensible attitudes possessed by participating staff, no such accident happened.

Finally, as stated previously, the SSEP offered an unprecedented opportunity for a lengthy projection of DSTO's image in the public eye. It is the author's opinion that this opportunity was never sufficiently exploited.

12. Acknowledgments

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RAN RAN executive management, NSA, CMDR J.Mathias (A-NSA), Lt G.E. Prince, CDRE R. Partington, Capt J. Wood, management and staff of all branches at HMAS STIRLING, management and staff of Lodger Units at Garden Island.

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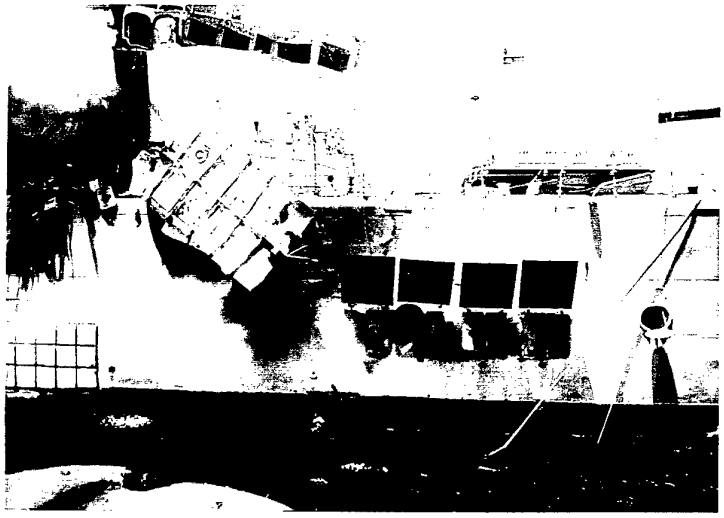

Figure 1: Fire in 3 F Mess

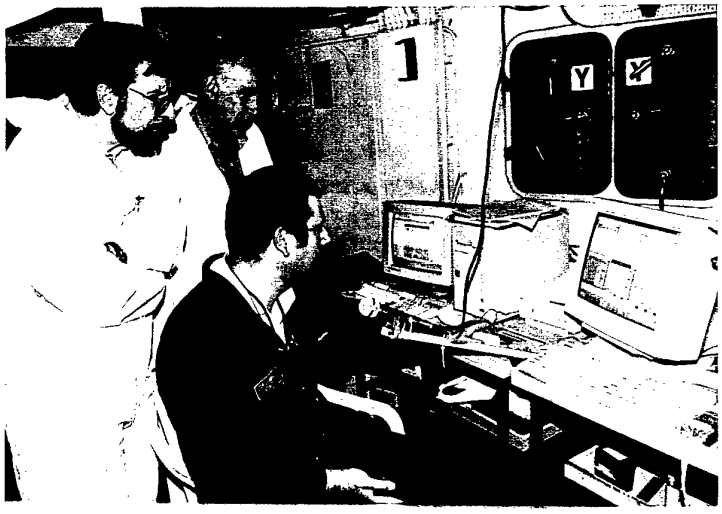

Figure 2: Monitoring and Recording Data for Smoke Experiments

Figure 3: Damage Control Team De-briefing.

Table1: Schedule of Experiments

Date	Event	Event No	Device	Location	Deck
1 - 5 Aug	Pulsed signals	UWB 1-5	UWB signals	DERWENT systems	
9 - 12 Aug	" "	UWB 6-9	UWB signals	DERWENT interiors	
19-26 Sept	Cold smoke	S1-8	CSS60-80	Tech. Planned Maint. Off.	2
27Sept-4 Oct	Hot smoke	S9-16	Hearth fires	" " " "	2
6 Oct	Panel fire	C7	Hearth fire	DSO's Cabin	2
10 Oct	Blast	C4	4.8 kg enhanced charge	Transmitter Rm (2 D)	2
12 Oct	Blast/frag	C14	7.8 kg cased charge	Electronic Warfare Office	1
17 Oct	"	C3	SM-1, mk 51	Seacat Missile Mag.	1
19 Oct	"	C6	76mm Oto-Melara, mk 199	Ikara Guid. Equip Off.	2
21 Oct	"	C13	4.8 kg cased charge	Combined Radar Off.	2
24 Oct	"	C5	5"/54, mk 64	Conversion Mach. Rm	3
27 Oct	"	C2	SM-1, mk 90	Operations Rm	1
1 Nov	Fire	C8	Ti / reactive cased charge + 20 l JP-5	3P Mess	3
3 Nov	"	C10	3 kg bare charge + 50kg solid prop.	3M Mess	3
10 Nov	"	C9	3 kg bare charge + 20 l JP-5	3F Mess	3
15 Nov	Blast	C15	4.8 kg enhanced charge	Wet Laundry (aft)	2
17 Nov	"	C16	7.8 kg enhanced charge	Corridor (aft)	2
22 Nov	Mine defeat	M1	LMDE V hull	Watertight comp't below cartridge magazine	4
22 Nov	" "	M2	SWAG V hull	" " " " "	4
23 Nov	Mine function above water	M3 and 4	Mine V hull	3 D Mess (port and stbd)	3
24 Nov	Mine defeat	M5	LMDE V limpet	Watertight comp't below cartridge magazine	4
24 Nov	" "	M6	SWAG V limpet	" " " " "	4
28 Nov	Mine function underwater (plate)	M7	Limpet V hull	" " " " "	4
30 Nov	" " " (frame)	M8	Limpet V hull	" " " " "	4
2 Dec	" " " (plate)	M9	Limpet V hull (flooded)	" " " " "	4

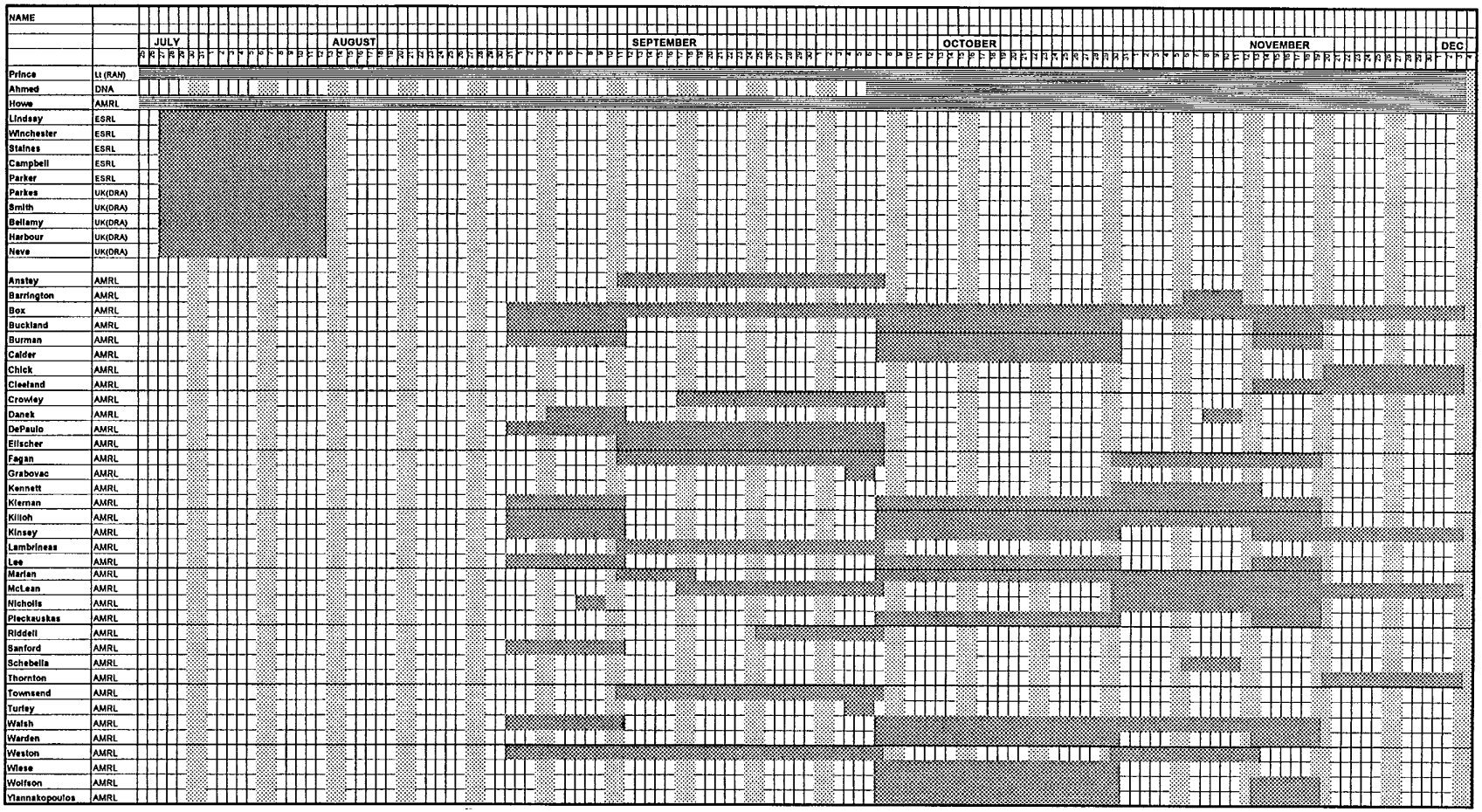

Table 2 Participating Personnel at Site

Table 3: Linear Peak Sound Pressure Levels From SSEP Experiments

Date	Time	Measurement Location	Location Distance	Wind	Explosive Mass	Measured Peak Noise Level	Comments
10 October	1520 hrs	Port Manager's bldg HMAS STIRLING On beach opposite Wanliss St Rockingham	900 m ≈ 6000 m	14 knots at 220° (from SW)	5 kg	103.5 dB ≤ 108.9 dB	not audible
12 October	1328 hrs	Port Manager's bldg On beach opposite Samuel St Rockingham	900 m ≈ 5800 m	9 knots at 270° (from W)	8 kg	130.1 dB 112.8 dB	clearly audible
17 October	1230 hrs	On beach near Rockingham Yacht Club	≈ 5800 m	12 knots at 216° (from SW)	30 kg	≤ 108.0 dB	not audible

Notes: 1. 0° / 360° = Wind from North
2. Ship located ~ due north of Rockingham Yacht Club
3. NAL recommended that the general public be not exposed to levels higher than 115 dB

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J.S. Howe

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19. ABSTRACT

The Ship Survivability Enhancement Program (SSEP) was devised to generate scientific data in research areas related to the survivability of ships and crews against attack from modern weapons. The experiments were concerned with electronic radiation, fire, smoke, exploding missile warheads and limpet mines. Damage control and fire fighting methods were also studied.

The experiments were carried out in 1994 on the recently de-commissioned RAN destroyer-escort, ex HMAS DERWENT, and there were specific criteria established for them to be accepted into the program.The site for the program were the waters of Cockburn Sound, close to the RAN facilities on Garden Island, the major Australian west coast naval base, which offered infrastructure support so important to the success of the work. The experiment schedule occupied nearly five months, requiring considerable movement of staff and equipment between their home bases and the test location.

This report describes the considerable planning and management measures required to satisfy all of the constraints imposed by the RAN and DSTO and these included the approved budget, risk management, environmental considerations and OH&S aspects. The report explains how the program required continual on-site liaison with essential support groups and how it was continuously monitored and controlled to ensure

that it was operating within the defined constraints and that scientific objectives were being realised.
The report starts with the setting of the objectives and management arrangements and the critical issues are addressed in detail. The support roles of the various Navy elements involved are defined. Risk management was a factor which required special attention, especially with its potential for negative publicity for the RAN and DSTO, should adverse situations have arisen. No such circumstances did occur. OH&S matters followed similar lines. The local PR campaign waged principally by the Public Affairs Office at HMAS STIRLING was an outstanding success and showed the benefit of pro-active publicity which was astutely managed by Navy.
The program was deemed to be an outstanding success. Nonetheless, there were lessons learned and these are also reported.
This report does not cover the scientific outcomes which are reported elsewhere by the task managers who directed their own experiments.